

# INCREASING QUALITY

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## INCREASING THE QUALITY OF DIAMOND WHEELS FOR EDGE GRINDING FLAT GLASS

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The quality of diamond wheels for edge grinding flat glass was increased by decreasing the relative consumption of diamond grinding wheels as a result of increasing the durability of the binder and using diamond powders with optimal coating. New diamond wheels based on a metal binder with volume content of nickel powder 40% and diamond powder with nickel coating 56%, which decrease the relative consumption of diamond by 20–30% with the roughness of the worked surface remaining unchanged are recommended for commercial use.

**Key words:** diamond wheel, grinding, edge of flat glass, relative consumption of diamonds, nickel coating.

Objects made of flat glass are finding wide applications in construction in the production of glass packages for window frames and in the furniture manufacturing [1]. Edge grinding is the most critical and laborious technological operation in the production of objects made of plate glass. In this connection, increasing the quality of diamond wheels for edge grinding of flat glass is an important problem facing the tool industry.

The quality of diamond wheels for edge grinding flat glass was increased by decreasing the relative consumption of diamonds by increasing the durability of the binder and using diamond powders with the optimal coating.

The investigations were performed by a method, regulated by GOST 16181–82, on a V3-318E model universal tool grinder with hydraulic longitudinal feeding. In accordance with the recommendations of [2, 3], the grinding was performed with wheels of the form 1A1  $100 \times 6 \times 5 \times 90 \times 32$  with a metallic binder, consisting of copper and time with HRB hardness 100–105 and concentration 62.5% and with AS65 diamond powder with grain-size  $90/75 \mu\text{m}$ , according to GOST 9206–80. The side edge of window glass with the dimensions  $150 \times 100 \times 4 \text{ mm}$  and grinding speed  $v = 25 \text{ m/sec}$ , feed rate  $S = 1500 \text{ mm/min}$ , and depth  $t = 1.5 \text{ mm}$  was ground with cooling by a water medium. The relative consumption of diamonds was determined in accordance

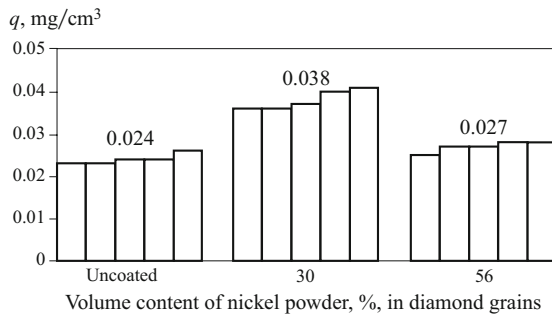
with GOST 16181–82 by weighing on VLT1-1-1 balances. Each experiment was repeated at least five times in order to determine the average value of the relative consumption of diamonds.

The strength of the diamond grains was determined in accordance with GOST 9206–80 and using the DA-2M apparatus, which was developed at the Institute of Superhard Materials at the Academy of Sciences of Ukraine [4]. For this, a diamond grain was placed between two parallel corundum plates and subjected to uniaxial compression under an evenly increasing force. The apparatus set the force under which fracture occurred. In accordance with GOST 9206–80, 100 grains were fractured in order to determine the average value. The shape factor of the diamond powders was monitored on the “Video-Test” apparatus using the method described in [5]. The shape factor was determined from the results of measurements performed on 100 grains. The measurement and analysis of the results were performed in a semiautomatic regime using projections of the grains on a computer monitor.

The quality of the nickel coating was monitored using the bulk density during free pouring and volumeter [5] as well as visually — using a BIOLAM microscope with  $\times 240$  magnification.

The effect of the binder durability and diamond powder coating on the roughness of the worked edge surface of flat glass was monitored. The roughness was measured with a model 201 profilograph-profilometer from the “Kalibr”

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**Fig. 1.** Relative diamond consumption  $q$  versus the nickel coating of diamond grains in the grinding wheels.

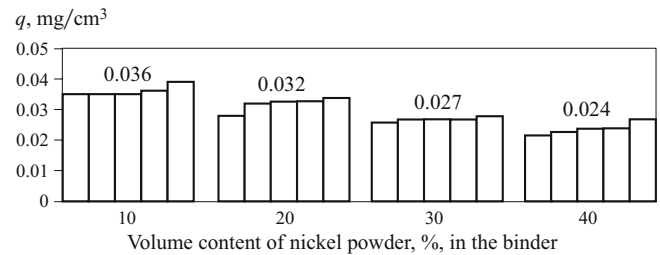
Works. The present investigations were performed in order to decrease the relative consumption of diamond by changing the binder durability and the diamond powder coating without an increase of the roughness of the worked surface of the edge of the flat glass.

To determine the optimal diamond powder coating, the dependence of the relative consumption of diamonds on the diamond-grain coating in the binder which did not contain nickel powder (Fig. 1). The results obtained showed that the use of diamond powder with 30 and 56% nickel coating (from the volume of the diamond powder, whose content was assumed to be 100%) in wheels for edge grinding flat glass did not decrease the relative consumption of diamonds as compared with the use of a powder without a coating.

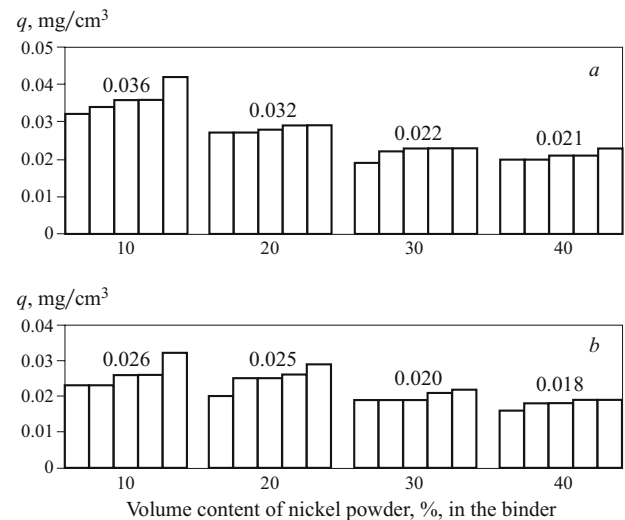
To increase the quality of diamond wheels for edge grinding flat glass, the desirability of increasing the durability of the binder by adding nickel powder to it was checked. For this, the dependence of the relative consumption of uncoated diamonds on the content of nickel powder in the binder was constructed (Fig. 2). A comparative analysis of the results showed that adding nickel powder (10 – 40%) to the metallic binder with *HB* hardness 100 – 105 (see Fig. 2) did not decrease the relative consumption of uncoated diamonds as compared with using a binder without nickel powder (see Fig. 1).

To increase the effectiveness of edge grinding of flat glass the desirability of the adding nickel powder to the binder and at the same time using diamond powder with a nickel coating was checked (Fig. 3). These investigations showed that such a double change decreased the relative diamond consumption as compared with using uncoated diamond powder in the binder without adding nickel powder (see Fig. 1). Diamond powder with a 56% coating (see Fig. 3b) resulted in a larger decrease of the relative consumption of diamonds than diamond powder with a 30% coating (see Fig. 3a).

The roughness parameter  $Ra$  of the worked surface of a glass edge with nickel powder content 10 – 40% (of the total volume of the glass) in the binder with 30 and 56% nickel coating. The results obtained showed that within the range



**Fig. 2.** Relative consumption of uncoated diamonds  $q$  versus the content of nickel powder in the binder.



**Fig. 3.** The effect of coating diamond grains on the relative diamond consumption  $q$  versus the nickel content in the binder when using diamond powder with nickel coatings 30% (a) and 56% (b).

studied the factors listed did not have a large effect on the roughness of the worked surface, which was 1.3 and 1.5  $\mu\text{m}$ .

As a result, new rings based on a metallic binder with nickel powder content 40% and with diamond powder with a nickel coating 56% were recommended for commercial use. At the present time, new wheels for edge grinding of flat glass are being used successfully at 10 enterprises in the Czech Republic and in Slovakia.

Thus the investigations established that the use of diamond powder with nickel coating 30 and 56% and with the previous metallic binder in wheels for edge grinding of flat glass does not decrease the relative diamond consumption as compared with the use of diamond powder without a coating.

Adding nickel powder (40%) to the metallic binder of grinding wheels containing diamond powders coated with nickel decreases the relative consumption of diamonds: by 10 – 15% with the use of diamond powder with a 30% nickel coating and by 20 – 30% using diamond powder with 56% nickel coating.

Adding nickel powder (10 – 40%) to the metallic binder and using nickel-coated diamond powders do not have a

large effect on the roughness of the worked surface, which is  $1.3 - 1.5 \mu\text{m}$  with diamond grain size 90/75  $\mu\text{m}$ .

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